REMARKS

Applicants would like to thank the Examiner for the thorough examination of the present application. Claims 9-10 and 16-23 directed to a Simon's quantum algorithm have been cancelled to advance prosecution of the present case. The remaining Claims 6-8 and 11-15 are directed to a Shor's quantum algorithm.

Independent Claims 6 and 11 have been amended to address the non-statutory subject matter rejection. Support in the specification may be found in paragraph 2, for example. The claim amendments and arguments supporting patentability of the claims are provided below.

I. The Amended Claims

The present invention, as recited in amended independent Claim 6, for example, is directed to a method for processing data in a database based upon performing a Shor's quantum algorithm as a function ($f(x)$) encoded with n qubits for factoring numbers within the database. The method comprises performing a superposition operation according to the Shor's quantum algorithm over a set of input vectors, and generating a corresponding superposition vector.

The performing comprises calculating as a function of the n qubits a value ($1/2^{n/2}$) of non-null components of the superposition vector, and calculating indices of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is 2^n. The method further comprises performing an entanglement operation on the superposition vector, and generating a corresponding entanglement vector. An interference operation

is performed on the entanglement vector, and a corresponding output vector representing at least one of the factored numbers from the database.

Independent Claim 11 has been amended similar to amended independent Claim 6, and is directed to a quantum gate for processing data in a database based upon performing a Shor's quantum algorithm.

II. The Claims Are Directed to Statutory Subject Matter

The Examiner maintains his rejection that independent Claims 6 and 11 are directed to nonstatutory subject matter. Independent Claim 6 has been amended to recite a method for processing data in a database based upon performing a Shor's quantum algorithm as a function ($f(x)$) encoded with n qubits for factoring numbers within the database. Paragraph 2 in the specification supports the claim amendment.

Similarly, independent Claim 11 has been amended to recite a quantum gate for processing data in a database based upon performing a Shor's quantum algorithm as a function ($f(x)$) encoded with n qubits for factoring numbers within the database. The Applicants submit that the independent claims are directed to a useful, concrete and tangible result. For instance, processing data in a database may be associated with cryptography. Support in the specification may be found in paragraph 2, for example.

III. The Specification Supports The Claims

The Examiner rejected independent Claims 6 and 11 based upon the claim recitation of "qubit." The Applicants

submit that "qubit" is defined in paragraph 50 of the specification as "quantum bits." A quantum bit is a unit of quantum information, and is a term readily understood by those skilled in the art. Consequently, quantum bit does not need to be defined in the specification since the entire application is directed to quantum algorithms. However, for the Examiner's reference, the definition of qubit provided by the on-line encyclopedia Wikipedia is attached.

The Examiner rejected dependent Claims 8 and 15 based upon the claim recitation of "cos," "int," and "sin." Support in the specification may be found in paragraph 84, for example. The cosine term corresponds to the real component, whereas the sine corresponds to the imaginary component as stated in paragraph 84. Each component is based on a product between a value of the non-null component and a summation of the respective cosine/sine functions.

Int(.) generates the integer part of the argument as also stated in paragraph 84. The integer part of a real number is the integer number composed of the digits on the left of the decimal point. For a more detailed explanation, the Examiner is directed to the web site www.mathworld.wolfram.com/integerpart.html.

IV. The Claims Are Patentable

The Examiner rejected the claims over the Ulyanov et al. published patent application in view of the Cleve et al. published patent application. The Examiner cited Ulyanov et al. as disclosing the claimed invention except for "calculating indices of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of

which is 1 and a difference of which is 2^{n}". The Examiner cited Cleve et al. as disclosing this feature of the claimed invention. The Examiner has taken the position that it would have been obvious to combine the cited prior art references to produce the claimed invention.

The Applicants submit that the Examiner has mischaracterized Ulyanov et al. Ulyanov et al. is directed to Grover's algorithm - and not to a Shor's algorithm as in the claimed invention. Consequently, Ulyanov et al. is not relevant to the claimed invention.

The Examiner seems to have taken the position that since both algorithm are quantum algorithm, then they are related. The Applicants submit that apart from belonging to the realm of quantum algorithms, Grover's algorithm is completely different from Shor's algorithm. For the Examiner's reference, the definition of Grover's algorithm and Shor's algorithm provided by the on-line encyclopedia Wikipedia is attached.

Nonetheless, Grover's algorithm uses superposition, entanglement and interference operations like all quantum algorithms. However, reference is directed to paragraph 296 in Ulyanov et al. - in which they are not the same for all quantum algorithms. FIG. 42 in Ulyanov et al. illustrates a Grover's quantum algorithm simulation including circuit representation and a corresponding gate design - which is different from the Shor's quantum algorithm simulation as shown in FIG. 6 in the Applicant's specification, for example.

Paragraph 512 in Ulyanov et al. refers to FIG. 20 that describes the general structure of an intelligent control system based on quantum soft computing (paragraph 47).

Moreover, the mentioned "quantum search algorithm" is the Grover's algorithm (Appendix 4), not the Shor's algorithm.

As for the dependent claims, the function p(y) in TABLE 3.1 on page 11 in Ulyanov et al. is a Probability Density Function, while Pi in equation 6 in the Applicants' specification is a component of a vector.

Paragraph 574 in Ulyanov et al. does not teach how to calculate indices of non-null components of the entanglement vector in terms of an arithmetic succession, but illustrates in FIG. 25 comparison of "GA and QSA structures" (paragraph 50).

It is not apparent why the Examiner states that "Equal" of the Applicants' application is equivalent to "applied" of Ulyanov et al. Moreover, the Applicants do not state that the entanglement vector equals the superposition vector, but that "the value of non-null components of the entanglement vector equals the value of non-null components of the superposition vector, as it is evident by looking at equations (6) and (7).

The Applicants also submit that paragraphs 317-318 Ulyanov et al. do not teach a memory buffer for storing indices (i or k). Instead, reference in this paragraph is directed to computing P by applying U_P to a register containing the superposition. This is different then simply equating a memory buffer with a register.

Referring now to Cleve et al., it is not apparent where the claim recitation "calculating indices of the 2^n non-null components of the superposition vector as an arithmetic succession, a seed of which is 1 and a difference of which is 2^n" is disclosed. Cleve et al. is directed to simplifying the

calculation of the Quantum Fourier Transform, but contrary to the Examiner's position, it does not disclose nor even suggest the Applicants' equation 6.

The Examiner has taken he position that the symbol O(...) corresponds to the claim recitation "a seed of which is 1 and a difference of which is 2^n". This is simply incorrect. The symbol O(…) is the Landau symbol, and does not represent an arithmetic succession. A basic explanation of the meaning of this symbol may be found on http://mathworld.wolfram.com/LandauSymbols.html or even in the Cleve's patent, cited by the examiner, at paragraph [0009].

Even if the references were selectively combined as suggest by the Examiner, the claimed invention is still not produced. Accordingly, it is submitted that amended independent Claim 6 is patentable over Ulyanov et al. in view of Cleve et al. Amended independent Claim 11 is similar to amended independent Claim 6. Therefore, it is submitted that this claim is also patentable over Ulyanov et al. in view of Cleve et al.

In view of the patentability of amended independent Claims 6 and 11, it is submitted that the dependent claims, which include yet further distinguishing features of the invention are also patentable. These dependent claims need no further discussion herein.

V. CONCLUSION

In view of the amendments to the claims and the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need

to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,

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